Northern California Compost Demonstrations Results

In 1994 the California Integrated Waste Management Board (CIWMB) funded five proposals from twenty-eight, cooperative team submissions for compost agricultural demonstrations. This market development stimulus was initiated to demonstrate agricultural use of mulch and compost made primarily from curbside collected green material (e.g., yard trimmings).

Overview of Cooperative Teams' Findings

Compost or mulch applications can be beneficial to California commercial growers of crops and nursery stock. Because of the benefits, many of the growers involved with these demonstrations continue to use compost and mulch made primarily from green material.

Benefits observed in one or more of these trials from repeated applications of compost include:

- Increased soil organic content,
- Increased soil pH in acidic soil,
- Increased crop yields (e.g., onions, lettuce, tomatoes, and sweet corn), and
- Specific disease suppression (e.g., brown rot and Fusarium end rot).

Compost varies according to the organic materials used to make it, the composting process used, and the stability of the product marketed. Generally, a good quality compost made from yard trimmings contains lesser amounts of nitrogen, viable weed seeds, and salinity than manure. Compost is an acceptable material for maintaining tree fruit quality, field crop production, and commercial nursery stock.

There is minimal potential for the leaching of nitrate ions into groundwater when a good quality compost is applied at agronomic rates.

Healthy plants usually resist disease better and result in greater crop yields. Therefore, certain soil management practices, including compost application, tend to result in better yields because they improve plant vigor. Conversely, some cultural practices or excess application of commercial nitrogen fertilizer can increase pest pressure on most crops with resultant crop quality and yield decreases.

However, predicting increased crop yields and disease suppression when using compost or mulch remains a challenge. The complex biological interactions that occur between the soil's organic matter, the diversity of microorganisms present, the commercial crop planted, and the unique micro-habitat is not clearly understood. Some initial expectations of growers may not be realized, especially in the short-term of any soil management program.

It is important that the grower have a soil management plan and establish a rapport with the compost or mulch producer before using substantial quantities of compost or mulch on a portion of their farm or nursery operation.

Typically in California, application of compost is during the fall (after harvest) and winter. For maximum benefit, field applications of compost or fresh yard trimmings should be in place at least one or two months in advance of the scheduled planting date. Appropriate application timing is especially important if the compost product continues to heat up when moistened and placed in piles or is directly incorporated into the soil.

Abstracts of the Agricultural Demonstrations

Certain elements were common to each of the five agricultural demonstrations. During the first of three growing seasons, effort focused on

involving local farm advisors as part of the cooperative teams. A standardized laboratory analysis for green material applied to each randomized, replicated plot was also established. A wide variety of commercial crops in northern California received annual applications of compost or mulch. Many of the cooperating growers were using compost in their operation for the first time.

The following sections are brief excepts from the cooperative teams' final reports summarized in June 1997. These compost publications can be downloaded in Word or WordPerfect via the Internet from the CIWMB's Home Page found at http://www.ciwmb.ca.gov. Copies of these compost publications are also available by calling the Recycling Hotline at (800) 553-2962.

Fresno County Demonstration
(Publication #422-96-051)

The composted green material, prepared mostly from home garden debris, was applied in a commercial Elegant Lady peach orchard over a multi-year period. The materials compared in this demonstration and research trial included:

- Ammonium nitrate,
- Steer manure,
- Composted steer manure,
- Pelletized chicken manure, and
- Green material compost.

All materials were applied with commercial equipment at a rate of 100 pounds of actual nitrogen per acre. Two additional treatments of ammonium nitrate and steer manure were applied at a rate of 300 pounds of actual nitrogen per acre for evaluation of nitrate leaching potential. All materials were compared to unfertilized control trees in a randomized complete block design, with four replications of 49 trees per treatment plot.

Data showed that green material compost can furnish the necessary level of nutrients to commercial peach trees and compares favorably to the other historically used fertilizers in the cultivation of stone fruits. Fruit yields, size, quality, and postharvest parameters were not significantly different among the treatments. No increase in either disease or insect damage was noted where the green material was used. In one year, there was evidence that brown rot disease was significantly reduced where the green material compost was used. Orchard-wide disease levels during the following two years were so low that validation of this observation was not possible.

A consumer taste test was performed on some of the peaches grown in the demonstration project. Consumers could not detect any differences among the treatments as far as sweetness, color, or aroma were concerned. They did find peaches grown with ammonium nitrate to be less mushy than the peaches grown with either manure or compost. This finding was consistent with the analytical tests performed on the fruit in the laboratory.

Monterey Bay Regional Compost Project
(Publication #422-96-050)

The Monterey Bay project demonstrated the viability of on-farm composting and increased awareness of the potential benefits of compost use in crop production. Most of the crop plots of broccoli, cauliflower, lettuce, onions, potatoes, and beets received one of the following treatments:

- 0 to 20 tons per acre of compost,
- ~120 pounds of sidedress nitrogen, and
- ~180 pounds of pre-plant plus sidedress nitrogen.

There have been varying results from the trials ranging from significant suppression of plant disease to crop pest damage due to a unusually high population density of a soil insect. Yield increases were observed for an onion field and one lettuce field, but not in another lettuce trial conducted in an adjacent county. Differences between compost sources, soil types, crop varieties, fertility management practices, and growing seasons are likely factors influencing

crop response. Compost applications appeared to influence soil nitrogen dynamics and soil microbiology. Conflicting results in onion trials regarding suppression of Fusarium end rot was observed. Disease suppression was evident in 1995, but not in 1996. This suggests subtle differences in compost characteristics contributing to quality. One cannot assume that all composts will provide the same benefits in the diversity of soils, crops, and management systems in this geographic region.

Agriculture in Partnership with San Jose (Publication #422-96-048)

San Jose's cooperative team investigated the use of fresh yard trimmings, semi-mature compost, and mature compost (produced commercially and on-farm) at the following rates:

- 13 to 40 tons per acre of yard trimmings,
- Nine to 30 tons per acre of semi-mature compost, and
- Five to 20 tons per acre of mature compost.

Commercial crops in Alameda, San Benito, and Santa Clara counties included apricots, cherries, wine grapes, peppers, radicchio, strawberries, tomatoes, Christmas trees, and walnuts.

Test results show that composting effectively eliminates weed seed viability. Composting for 30 days usually kills all the seeds and other viable plant parts. Fresh yard trimmings, in comparison, can have substantial numbers of viable seeds and are not suitable for applications where weed growth would be of concern.

In general, crop yields were not significantly influenced by the addition of organic matter. The use of mature compost did not increase yields, nor did the use of fresh yard trimmings reduce yields. The trial results show that potential benefit from these amendments lies more in improved soil quality than in short-term crop yield increases. Increased soil organic matter can result in the slow release of nutrients over a longer period of time with minimal leaching to ground water. There appears to be no short-term negative impact in the form of nitrogen deficiency, disease incidence, or uncontrollable weed pressure.

The "Yard Trimmings Products Use Guide," (Publication #422-96-049: Appendix E of San Jose's final report) is separately available.

Stanislaus County Compost Demonstration (Publication #422-96-053)

The Stanislaus County team designed trials to measure benefits of compost use on ornamental nursery stock and on field crops. The nursery trials were conducted for two years and the field crops for three years. Different rates of compost were used as follows:

- Grower's potting mixes containing 0, 25, 50, 75, or 100 percent compost, or
- Compost applied at rate of 10 or 20 ton per acre compared to a commercial fertilizer treatment and untreated control field plots.

The nursery trials used five commonly planted landscape plant species: Fraser's Photinia, Chinese pistache, Gold Coast Juniper, Pink Indian Hawthorn 'Springtime' and Belgian indica azalea. The field crops consisting of sweet corn, watermelons, and tomatoes were selected for their different root systems and growth patterns.

The trials showed that the five species of ornamental nursery stock can be successfully grown in potting soil that contains compost. Compost was shown to have several good qualities as a component of potting soil. Preplant soil tests showed that potting media containing compost has greater nutrient-holding capabilities than media that lacked compost, especially for nitrogen. For most of the plants tested, a 25 percent compost and potting soil mix performed well as a growing media.

The field trials of sweet corn, tomatoes and watermelon on sandy soils showed that compost treatment beneficially changed soil structure and significantly increased soil organic matter and pH in this acidic soil. Compost increased tomato and sweet corn production when applied at the 10 ton per acre rate.

The fine texture of compost also increases the soil's water-holding capacity. This may have important implications for water savings in field crop production and potted plants.

Tulare County Compost Demonstration (Publication #422-96-052)

The Tulare project demonstrated the use of green material compost. Three treatments were compared on each season's crop:

- Commercial synthetic fertilizers without soil amendments,
- Poultry manure in conjunction with commercial synthetic fertilizers, and
- Green material compost in conjunction with commercial synthetic fertilizers.

Each treatment, replicated three times in a randomized complete block design, was approximately 3.6 acres. In 1995, compost was applied at 3.5 tons dry weight per acre, and in 1996 the rate was 3.9 tons dry weight per acre. Analyses proved that compost provided some nutrients and a lower level of salts than manure.

Cotton was planted in the first year of the demonstration with a preplant starter fertilizer applied to all treatments. During that season, nitrogen was sidedressed on all treatments, but the compost and manure treatments received 60 pounds less nitrogen per acre than the conventional treatment.

Wheat was planted after cotton. The second compost application was applied following harvest of winter wheat and prior to planting silage corn. In addition to the original compost treatments, compost at the rate of 20 tons dry weight per acre was applied during 1996 on either side of the initial demonstration. Stand counts, gypsum block readings, and tissue analyses were taken from all treatments.

No significant differences in yield were observed in cotton or wheat. In corn, the compost treated plots yielded statistically less than conventional and poultry manure plots. This may have been a result of the irrigation pattern since it took several days to irrigate and the compost plots were always watered last.

This demonstration showed that compost is amenable to large-scale commercial agriculture application. Analyses demonstrated that compost provided some nutrients and was lower in salts than poultry manure. Commercially available loading, hauling, and spreading equipment routinely handled the compost. Given that there was no tangible or measured benefit from two years of low rates of green material compost or from one year of a relatively high rate, the short-term economics of green material compost applications in field crops do not seem favorable. It remains unknown whether there would be benefits to cotton, silage corn, or wheat from long-term applications at relatively low annual rates.

The Next Phase

CIWMB, the City of San Diego, the City of Los Angeles, and the County of Santa Barbara are financing a compost and mulch demonstration in a four-county area of southern California. Commercial orchards are being evaluated for disease suppression of *Phytophthora cinnamomi* (avocado) and crop yields (avocado and citrus) over the next two years.

CIWMB staff are working with the USDA Natural Resources Conservation Service to promote agricultural use of compost and mulch made from green material. USDA programs on soil health and erosion control for California agriculture are considering the use of compost and mulch products made from green material.

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